FIRE

Project title: Fire: A Force for Change and Regeneration in Natural Ecosystems

Principal investigator: Dr. John Burger
Phone: 603-862-1736
Email: jfb@cisunix.unh.edu
Address: Department of Zoology
Spaulding Hall
University of New Hampshire
Durham, NH 03824

Objective: To study the long-term changes in re-vegetation at sites affected by different fire intensities, with emphasis on lodgepole pine, aspen, and whitebark pine

Findings: Selected sites throughout the park were examined to determine differences in rate of growth of lodgepole pine seedlings/saplings and in the onset and rate of reproduction in lodgepole pine. Growth rates are minimal in some areas (10-20 cm/yr; Frying Pan Spring; Norris-Canyon site) and high in other areas (40-60 cm/yr; Madison Jct., Norris Geyser Basin; Norris-Canyon blowdown; Miller Creek trail sites). Tallest sapling measured in 2000 was 1 mi. S. of Norris Junction in an area of vigorous regrowth, 444 cm. With estimated age of 12 years. Regeneration of whitebark pine also was examined along the Hoodoo Basin trail and the Canoe Lake trail. The eastern boundary ridge between Canoe Lake and Bootjack Gap also was examined for the first time since the 1988 fires and showed signs of very heavy grazing by elk. Comparative photographs were taken at selected sites for comparison with pre-fire and early post-fire vegetation. These are/will be used in teaching modules on fire ecology and also have been used by Mary Ann Franke in her publication on research since the 1988 fires. Aspen mortality at sites near Blacktail Deer Creek appeared to be much higher in 2000 than in previous years, with about 25 percent of the above-ground stems dead.

Project title: Post-Burn Resource Selection, Physiological Condition, and Demographic Performance of Elk

Principal investigator: Dr. Robert Garrott
Phone: 406-994-2270
Email: rgarrott@montana.edu
Address: Montana State University
Biology Department
310 Lewis Hall
Bozeman, MT 59717

Additional investigator(s): Adam Messer

Objective: The primary objective of this research is to evaluate the consequences of the 1988 fires on elk resource selection. Selection is being quantified for populations and individuals at multiple scales ranging from selection of patches within the landscape mosaic to selection of forages and plant parts within patches. The physiological and demographic consequences of observed resource selection strategies are being assessed through noninvasive urinary and fecal assays, and telemetry. Secondary objectives include basic research on forage plant chemical compositions, plant-animal interactions and applied research to develop practical and rigorous management tools for population monitoring (aerial surveys, fecal steroid pregnancy assays, and snow-urine condition indices).

Findings: We have been successful in developing, testing, and applying a suit of research tools that is significantly enhancing our ability to address questions of animal resource selection and the physiological and demographic consequences of selection patterns. We have completed our ninth field season of data collection and maintain an instrumented population of 30-40 cow elk. Most publications to date have focused on techniques including population estimation, pregnancy assessment, and nutritional indices. This year we completed a manuscript analyzing the demographic data collected during the first seven years of research which is currently being considered by *Ecology*. Adult survival and reproduction is near the biological maximum for the species, but recruitment is highly variable, being strongly influenced by environmental variation, primarily winter severity. Despite this variable recruitment, extensive Monte Carlo simulations indicate that the population is relatively stable and is being regulated at approximately 600-800 animals. We have generated a database of greater than 9000 animal locations and are exploring a variety of analytical tools for the analysis of these data. An ArcView GIS database has been developed that integrates landscape features with all spatially-explicit databases collected on this study. We are currently developing spatially-explicit snowpack models in collaboration with NASA scientists to enhance our analyses of elk resource selection.

Project title: Dynamics of Climate, Fire and Land Use in the Greater Yellowstone Ecosystem

Principal investigator: Dr. Lisa Graumlich
Phone: 406-994-5320
Email: lisa@montana.edu
Address: The Mountain Research Center
106 AJM Johnson Hall
Montana State University
Bozeman, MT 59717-3490

Additional investigator(s): Jeremy Littell, Sean Hill, Lindsey Waggoner

Objective: To answer the following questions: 1) What was the spatial and temporal variability of pre-20th century fire? I will use these preliminary results to define the variability of fire regime as affected by elevation gradients and other topographic controls of climate. In addition, I will assess whether fire regimes have changed over the past several centuries. 2) How did climatic variability affect pre-20th century fire regimes? I will compare palecoclimatic data with pre-20th century fire data to characterize the impact of climate on fire regimes. 3) How significantly has 20th century fire exclusion changed the aboveground car-

bon pool? I will compare current aboveground carbon pools with inferred past carbon pools based on a reconstruction of the landscape. I will seek corroboration of these patterns using two model- based approaches.

Findings: In fall 2000, we selected our first field sites for this project in the northern range at Crevice Lake and Soda Butte Creek. We developed a 350-year Douglas-fir chronology at Soda Butte Creek that cross-dates reasonably well with previous sampling at Mt. Everts. We also began sampling increment cores for stand age class analysis at Soda Butte Creek. Fire scare distribution and density were assessed at both sites to apply for the initial permit. We will begin sampling these sites in spring 2001 and continue through summer 2002, fire weather permitting. Samples are archived at the Mountain Research Center.

Project title: Forest Fire Regrowth

Principal investigator: Mr. John Graves
Email: graves@montana.edu
Address: 6001 Monforton School Road
Bozeman, MT 59718

Additional investigator(s): Monforton School students

Objective: To collect regrowth data including percent of coverages of grasses/sedges, forbs, moss/lichens, trees, litter, bare ground. Heights of grasses and trees are also measured and recorded.

Findings: percent grasses/sedges: 14.2; percent forbs: 16.3; percent moss/lichens: 21.8; percent trees: 8.8; percent litter: 35.5; percent bare ground: 3.5; height trees: 81.9 cm; height grasses: 45.4 cm. Data from all years of the study is available at http://www.mcn.net/~monfort/YPFall2000/regrow00.html.

Project title: Impact of Fires of 1988

Principal investigator: Dr. Daniel Norton
Phone: 303-236-2484
Email: drnorton@ecentral.com
Address: USGS Geologic Division
Mail Stop 973, P.O. Box 25046
Federal Center
Denver, CO 80225

Objective: Annual studies of foliage, ash and soil to track the changes in physical and chemical properties of collected materials. Sleeve tests of ash and soil. Visual microscopy of ash and soil separates. Photographic records of selected sites, measurement of ash layer, description of site.

Findings: The sites on level terrain for the most part continued to reveal an average of 0.5 inch of black

ash with small variation year by year. These sites were on forested terrain. Deviation from this result occurred on slopes that were washed by rainfall and on course soils in open terrain exposed to wind. Most dramatic is the marked increase of grasses, shrubs, and plants in the sites of level terrain in wooded areas containing considerable moisture.

Project title: Postglacial Fire Frequency and its Relation to Long-term Vegetational and Climatic Changes in Yellowstone Park

Principal investigator: Dr. Cathy Whitlock
Phone: 541-346-4566
Email: whitlock@oregon.uoregon.edu
Address: Department of Geography
University of Oregon
Eugene, OR 97403

Objective: The primary objective has been to study the vegetational history of Yellowstone and its sensitivity to changes in climate and fire frequency. To establish a vegetational history, a network of pollen records spanning the last 14,000 years has been studied from different types of vegetation within the park. A reconstruction of past fire frequency is based on information gained from 1) a study of the depositional processes that incorporate charcoal into lake sediments; 2) a comparison of charcoal and dendrochronological records of fire occurrence during the last 750 years; and 3) an analysis of charcoal, pollen, and magnetic properties in lake-sediment cores spanning the Holocene and late-glacial periods.

Findings: Progress was made on three aspects of this project. First, the Trail Lake record has been written up and will be submitted in the coming year for publication. This record reflects the new chronology and a basal age of 8000 years old.

Analysis of the sampling of modern sediments in lakes with watersheds that were burned in 1988: this process-based study provides information necessary to interpret the charcoal record in sediment cores, by determining the time of charcoal accumulation following a fire event. This study is unique, and the results have been used by researchers around the world. The results are discussed in three manuscripts.

Third, we are collaborating with scientists from the USGS to evaluate the paleoecological history of Yellowstone lakes to past climate change. Samples have been analyzed for sediment geochemistry. Special attention has been directed to northern range lanes, particularly Crevice Lake. Crevice Lake has annually laminated sediments and cores will be taken in February 2001, as part of collaborative project with the USGS and University of Nebraska.

Other accomplishments of note are 1) publication of the fire history from Cygnet Lake in the journal *Geology*; 2) acceptance of a manuscript on the paleoecological record of plant invasions, to appear in *Western North American Naturalist;* 3) acceptance of two papers on charcoal methodology; 4) acceptance of a manuscript on the prehistory of the Rocky Mountains; and 5) presentation of results at annual meetings of the American Geophysical Union, American Association for the Advancement of Science, and Association of American Geographers.

Project title: Fire Effects Monitoring in Yellowstone National Park

Principal investigator: Yellowstone National Park Fire Effects Crew
Phone: 307-344-2362
Address: P.O. Box 168
Mammoth, WY 82190

Additional investigator(s): Mitch Burgard, Eric Miller, Todd Carlson

Objective: Monitor the effects of prescribed fire on Yellowstone's ecosystems. Provide information to evaluate whether the objectives of the fire management office are met. Study the long-term effects of fire on the landscape.

Findings: The Yellowstone Fire Effects Crew established several plots ahead of naturally occurring wildfires during the particularly active 2000 fire season. We installed five monitoring plots ahead of three fires: Two-Smokes, Boundary and Plateau. The first plot (Two-Smokes) was installed in a smoldering tree island in the meadow complex on the Pitchstone Plateau in the southwestern corner of the park. In the following weeks the fire burned the rest of the tree island and spotted across the intervening meadow into two other tree islands. The plot was resampled on September 13.

We installed two more plots on the Boundary Fire at the south end of the park. This fire was ignited by lightning on August 15 in a forest of twelve year old lodgepole pines regenerating an area that was overrun by crown fire in 1988. One plot burned on August 22, a day after installation. The other burned about five days later. These two plots are interesting because the young cover type (LP0) was not expected to carry fire as well as it did. Fire carried through the sedges when possible and otherwise resided in rotten logs outside the burn period. We found that old, rotten logs were completely consumed while the more solid logs resulting from trees killed in 1988 were only scorched and partially burned. We found that the fire would not consume logs with a bulk density (a measure of "rotten-ness") greater than 0.34 grams/cm3. This figure, as well as the vegetation data from this year's sampling and future resampling, may be applied to the vast areas of the park that are regenerating from the fires of 1988 and will aid our predictions of future wildfire behavior in this cover type. The last two plots were installed on the Plateau Fire near Buffalo Lake Cabin but neither of them burned.

We also visited two fire plots established in 1977 and 1988 by Don Despain. Despain's dataset is comprised of twelve plots installed between 1977 and 1989 and periodically resampled every few years thereafter. We presented some of these results at the Second USGS Wildland Fire Workshop in Los Alamos in early November, and are currently working toward publishing this information in a paper. We installed one plot in the proposed prescribed burn unit at Grant Village. This plot, in addition to several other plots in the burn unit will allow us to ensure fire management's objectives are met, and to monitor post-fire effects resulting from the burn.